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原始观音座蓮屬(*Archangiopteris*)的正誤研究*

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最近几个年代里，古生物学的研究，所积累的大量証据已充分揭示了在进化上显然已不再是很活跃的观音座蓮目(Marratiales)。这羣蕨类植物，不仅是現代蕨类植物中最古老的一羣植物，并且还証明了观音座蓮蕨类型的植物在地球上的存在是漫长而古老的，它的起源和历史发展可以追溯到古生代的上半紀。当时在地球表面上的許多地区(包括向北分布到北緯70°以北的地区，如格陵兰)，已出現了許許多多的現在已成为化石的观音座蓮蕨类型的植物(如 *Scolecopteris, Asterotheca*)。它們的內部构造和孢子囊羣的特征已显示和現代还活着的而仅只分布于北緯30°以下(如峨嵋山)的殘遺代表有着极大的相似之点。虽然具有高聳乔木状主干(如星囊蕨，*Asterotheca arborescens* 的主干高达10米以上)和蕨类形叶体、并且生长着和近代观音座蓮相同的子囊羣的植物，远在古生代的后期已被发現，但毕竟一直到了中生代的前半期的地层里，人們才第一次見到了在体形上和子囊羣的結构上眞正近似于近代型的这羣植物，而这羣植物的最繁荣时期却开始于石炭紀的末期，經过侏罗紀一直到白垩紀的整个漫长的时期里，它們曾代表着广泛分布的三十个以上的属，并且是当时地球上面植被組成的优势分子。实际上，近代观音座蓮目是整个近代蕨类植物門中的唯一的植物羣，它在亲緣关系上能和許多最古老的化石植物具体的联系起来，可以清楚的看出它們之間在演化上的来龙去脉。

从古代很长一个时期里，在种属数量的繁多上和分布的广泛性上，曾經盛极一时的观音座蓮蕨类植物羣中到今日还存在的孑遺植物只有六个属，代表大約三百多个种。它們广泛分布在地球上的热带和亚热带地区，如多孔蕨属或称单蕨属(*Danaea*)分布于南美洲；合囊蕨属(*Marratia*)分布于东西两半球；观音座蓮属(*Angiopteris*)分布于东半球，向北展延到亚洲大陆的东南和西南部；大叶观音座蓮属(*Macroglossum*)与天星蕨属(*Christensenia*)只分布于馬来亚羣島的个别地区，并且后者向北延展到亚洲大陆的热带边緣，而有趣的原始观音座蓮属(*Archangiopteris*)按它的現时分布，却是云南东南部——东京地区特有的蕨属，向东經广西南部伸展至海南島和台湾，还未发現于其他任何地区。如已被知道的那样，在系統发育上，这羣古老的植物在近代蕨类植物的很长以来的进化过程中，显然已不再参加什么活动了，而它們近代的孑遺种几乎还停留在和它們祖先的同一进化水平上。因此，它們在近代蕨类植物中除掉瓶尔小草目(Ophioglossales)外，实在还找不到和它

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們在古老性上相同的伙伴了。瓶尔小草目的植物，虽然从它的内部解剖和子囊羣的形态特性看，也是代表着极其古老的植物羣，很可能还要老过观音座蓮蕨羣，但到現在为止，却还沒有在古生代的地层里找到它的祖先的遺骸——化石，因此还不能判定它的起源的絕对地質年代。

观音座蓮目的六个属中，有三个属产于中国热带及亚热带地区。其中观音座蓮和原始观音座蓮这两个属很早以前就知道了；而第三个属叫天星蕨属(*Christensenia*)在中国的发現只是两年以前的事，也是在云南东南部被发現的，它的代表种叫做 ***Christensenia assamica*** (Griff.) Ching，(新組合)，原产印度北部，它和馬来亚地区产的 *C. aescurifolia* (Bl.) Maxon 是不大相同的，虽然过去是被認为同一种的。

在簡单地介紹了整个观音座蓮目的一般历史起源和地理分布之后，讓我們轉移到本文的主題——原始观音座蓮的討論。在此以前，对它的形态特征，系統分类和地理分布等方面还是了解得不多的，玆扼要分述如次：

一、历史起源

根据已知的化石材料，現在似乎可以比較肯定的說，原始观音座蓮的历史起源可以追溯到石炭紀时代的一些植物，特别是 *Danaeopsis fecunda* Halle 可以說是本属的原始型。因为从它的羽片形体和子囊羣的結构看，都显得同原始观音座蓮相同，虽然它的主脉間的小脉是网状型的，这可能是叶片加寬的結果。

在系統发育上，原始观音座蓮被認为是古老的观音座蓮目的进化系列上的最高的一支，它和观音座蓮的关系最为密切，前者可以被認为是后者的直属后代，但由于通过了漫长的历史演化过程，获得了自己特有的一系列的特征，形成了厚囊蕨类在进化路綫上一个最新的里程碑。

二、地理分布

在地理分布上。原始观音座蓮自成一个小区域，大約位于北緯 19—24°30′ 与东經 106—122° 之間的一条东西走向的狭长热带和亚热带季雨常綠林的地带，在这里的湿潤山地原始森林里也还茂盛地生长着观音座蓮属的許多种，并且在这里也第一次发現了同羣的天星蕨属(*Christensenia*)。从現在已知的种的分布来看，可以說云南东南部——北越这个地区是原始观音座蓮蕨的发源地和分布中心，向东經广西南部展伸至海南島及台湾。近年来的研究指出，云南东南部从它整个植物区系发展史来說，已有許多例証可

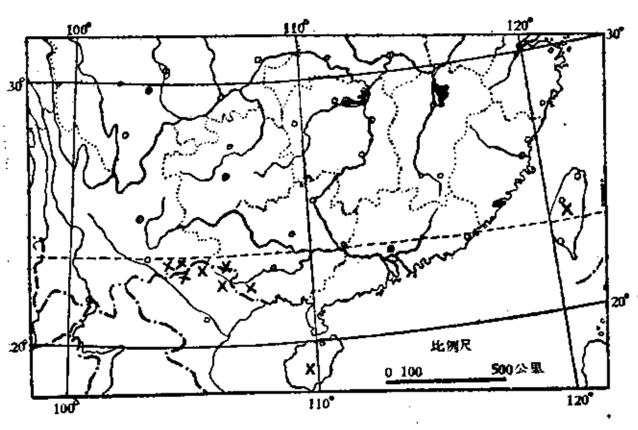


图1 原始观音座蓮属的地理分布

Fig. 1 A map showing geographical distribution of Archangiopteris Christ et Gies.

以說明本区是許多比較古老的殘遺植物种属的分布中心或发源地。这些古热带植物区系自第三紀以来在比較稳定——特別是未遭到冰川的侵袭的气候条件和相当复杂的地形变化下，形成了一个自然避难所，使这些种类不仅保存下来而且有些还可能繼續获得发展。原始观音座蓮就是古代殘遺植物区系的一分子在这个地区里发展起来的一个例子（参閱图1）。

三、形态特性

原始观音座蓮属是瑞士蕨类学家 Christ 和 Giesenhagen 二氏于 1899 年根据英国 Augustine Henry 氏在云南东南部的蒙自区采得的标本而建立的，曾被認为是个单种属。它的发現曾經引起了世界植物系統分类学家和形态解剖学家的极大兴趣，但由于缺乏新鮮材料，在解剖方面至今还沒有很好地加以研究。在它被发現后的二十余年中，在毗邻云南的越北地区又发現了二种，1919年又在台湾也发現一种，1935年又在越北发現一种，至1935 年止共有五种。但在过去的二十余年中，通过中国植物学家們自己的活动，从他們所采集的材料中，經过研究，又发現了五种，都产于云南东南部的湿潤山地常綠闊叶季雨林中。

在这里要說明的主要的并不在于发現了新种的数目，而却在于由于这些发現和进一步研究了过去已知的种类的結果，揭露了一些在形态上的新的特征，使我們对这一羣从远古殘遺下来的植物的許多方面获得了比較全面的認識。总結起来，有如下几点：

（1）从来学者們認为，作为原始观音座蓮的形态特征之一，是这羣植物的叶体总是“一回羽状”的，在有关文献里都是把这一点作为区别于有“二回羽状复叶”的观音座蓮属的特征之一的，但随着一种二回羽叶种（*A. bipinnata* Ching）在云南东南部的被发現，这个特征已經不再是原始观音座蓮的一个重要的了，虽然一回羽叶仍然是它的一般形态通性。

（2）从来学者們認为原始观音座蓮的細长綫形子囊羣下面一般具有夹絲，叫做“腱毛状的鱗片”或者“假子囊羣盖”，現在从所有已知种的研究，証实了夹絲并不是一种什么鱗片，而实質上就是毛，形态上叫做夹絲。它們在子囊羣下面的存在不只是个經常的属的特性，而且这些由柱状或棒状的多細胞組成的节状淡棕色的毛并不是单毛（有时有腺状的头），而毫无例外地都是分枝状的毛。至于毛的长短乃和不同的种类有一定关系的，在大多的种，夹絲的长度是等于或稍长过于孢子囊的高度，但在另两个种，它們的夹絲則远比孢子囊为短，隐藏于孢子囊羣的下面，因此，从孢子囊羣上面观察，却看不到它們的存在；在另一个种（*A. hokouensis* Ching），它的夹絲由多达 15 个柱状細胞組成，要比子囊大約长过二倍，而且多而密生，使发育着的孢子囊羣好象要从絨毛茸中鉆出来似的。

（3）在原始观音座蓮的所有种的叶柄上，如同南美洲产的多孔蕨属（*Danaea*）一样，大約在它中部以下的部位，生有一个有沟槽的肉質节状隆起，但有趣的是，在一个新发現的种（*A. hokouensis* Ching），它的叶柄上却具有 4—5 个同样的节状隆起，排列于整个叶柄的各部，因此，看起来好象竹桿一样。可以指出，近代观音座蓮蕨目在它們叶柄上的这种不平凡的节状隆起，对于生物体有着相当重要的生理上的意义的，因为这种內部充滿液汁的节状隆起，証明是生物体在生理过程中，用来調节叶面对于阳光的方向和強度（即空气

湿度的变化)的一种有效机制，根据需要或不需要，用来控制整个叶体下垂或是上升运动云。

(4) 众所周知，原始观音座蓮属，得以区别于观音座蓮属的另一个特征是它的由40—60—160个孢子囊組成的长綫形孢子囊羣，而在新发現的一种里(*A. hokouensis* Ching)却有由多达240个孢子囊組成的长达3.5厘米的孢子囊羣，而在另一个新种里卽 *A. bipinnata* Ching，孢子囊羣一般只由20个孢子囊組成，也有更少的，这都是过去未曾見过的現象。

(5) 在原始观音座蓮属的种类里，过去不知道有所謂"逆行假小脉"的存在，卽在两条眞脉中間从叶边出現向中肋方向倒行的一根"假脉"，这种現象在观音座蓮属的許多种是相当普遍的。但在越北发現的一种原始观音座蓮(*A. Cadieri* Tard. et C. Chr.)的各对眞脉中間竟然同样出現一条"逆行假小脉"的存在。不但如此，它的較短的(35—50个孢子囊組成)孢子囊羣的位置也和其他的种类有所不同，它不是生于叶边与中肋之間，而是生于靠近叶边，好象观音座蓮蕨属的种一样。由于这个种的发現，更足以証明原始观音座蓮这羣植物是直接起源于观音座蓮属的，而不应該認为是一个趋同現象。应該指出，由于这些証据和其他形态特点的不同(如鱗片的形成，腹背状的根莖等等)，正如上面已經指出那样，原始观音座蓮在它被发現的当时，Christ 和 Giesenhagen 两氏認为是代表极原始的蕨类植物，因而叫它为 *Archangiopteris*，而現在从形态发生的研究，知道这个名詞的含义是很不妥当的，因为它在历史演化的阶段上并不比观音座蓮属更古老、更原始。相反的，应該是后来的或是派生的一支。

由于以上一系列的新特征的发現，原始观音座蓮和观音座蓮这两属的概念，在許多方面起了一些重大的变化，甚至有些过去被認为的区别，如果不認为已經站不住的話，現在至少已經大大的削弱了。虽然如此，由于許多新特征的发現，这两个亲緣相近的属之間的区别仍然是眞实的，不可混淆的。因此，关于原始观音座蓮属的界說概念应有重新厘定的必要，同时关于两个属的区别，也有重新划分的必要。

虽然我們承認了原始观音座蓮属在亲緣关系上最接近于观音座蓮属，但它具有如下一些形态上的基本特征：

(1) 整个形体較小，較簡化和較細弱。

(2) 根莖頗細长，斜出，为腹背型。

(3) 总叶柄細弱，肉質，基部具一对肉質的大橢圓形的宿存托叶，至少具一个，有时多至五个沟槽状的肉質节状膨大，干則变为扁压而黑色。

(4) 鱗片相当发达，尤以叶柄下部为多，披針状，具粗篩孔，基部卵圓形，深心脏形，腹部着生。

(5) 叶一般为一回奇数羽叶，少为二回羽叶，羽片大而少数，通常1—5对，闊披針形，小叶柄膨大，干則变为黑色。

(6) 子囊羣长，一般由40—240个分离的孢子囊組成，不为叶边着生，而却着生于中肋与叶边之間的中部，下部有很多分枝的节状多細胞夹絲衬托。

(7) 孢子具有微細刺状密生的外孢壁。

四、系統分类

原始观音座蓮屬

Archangiopteris Christ et Gies. in Flora **86**: 72—85, 1899.

本属为中型陸生蕨类植物，生于热带山地常綠闊叶林中，根状莖頗长，亚直立或斜生，有腹背之分和肥粗肉質不分枝的长根疏生；叶簇生，通常3—4成丛，柄长，頗細，肉草質，上面有一寬縱沟槽，近基部处有不少长綫形暗棕色具粗篩孔的鱗片，腹部着生，边緣有粗齿牙，向上部疏生或几光滑，基部有一对頗大的薄肉質卵状长圓宿存的托叶状的附属物包围，向中部有一个（有时4—5个）肉質节状膨大，上面有縱沟，干后成扁压，呈淡黑色；叶片卵形到卵状三角形，比叶柄为短，照例为一回奇数羽状，少有二回羽状，羽片一般为1—6对，互生或亚对生，闊披針形，渐尖头，有小柄，頂生一枚羽片同側生的同形而通常較大，小柄也膨大，干后也变淡黑色；叶脉分离，从中肋向外斜向上开展，一次分叉或为单脉，明显，直达叶边，多少向上弯弓，頂端尖削，不具倒行假脉（*A. Cadieri* 除外），草質或紙質，綠色，上面光滑，下面通常鱗片疏生；孢子囊羣为长綫形，沿叶脉中部着生，照例位于边緣与中肋之間，但既不达中肋也不达叶边，每羣由20—60—160—240个，船形的无柄分离的成两排紧靠的孢子囊組成，孢子囊的頂部有不发育的胚带幷以腹部的一縱縫开裂，放出大量孢子，下面有沿叶脉着生的夹絲，夹絲的长短不一，节状，腺头，透明，分离，干后易擦落；孢子略圓或闊卵圓形，乳黄色，透明，表面有短細刺头密生的外孢壁。

本屬为一个很自然的属，現有10种，产云南东南部及越北，向东分布到广西南部，海南及台湾。

毫无疑問，本属同观音座蓮属有着密切的亲緣关系，其不同之点为植株形体較小，較簡单和較細瘦，根状莖頗长，亚直立，有腹背之分，細瘦的叶柄基部有两瓣薄肉質卵状长圓形的托叶，接近中部有一个（有时更多的）有沟槽的肉質节状膨大，叶柄下部有狹长形具粗篩孔的鱗片，边有粗齿牙，腹部着生，叶片远較小而簡单，通常为一回奇数羽状，只有不多几对远較大的有小柄的羽片，孢子囊羣远較細长，由更多的（一般40—240个）孢子囊組成，生于中肋与叶边之間，下面有节状分枝的夹絲密生和有密細刺头的孢子。

自从1899年 Christ 和 Giesenhagen 两氏根据在云南东南部（大围山）的标本，发現了原始观音座蓮属以后，日本植物学家早田文藏（Hayata）氏曾将本属的界說大大地攪乱了一番，他在不到十年的时間內，根据越北及台湾标本，連續发表了两个新属，卽 *Protomarratia* 和 *Protangiopteris*。当他发表 *Protangiopteris* 属时，他显然对原始观音座蓮属的特征的認識是极为模糊的，于是提出了他認为是他的新属的三个特点，就是叶柄中部以下有一个节状膨大，羽片的小柄不膨大（?），和孢子囊羣下面有作为假孢子囊羣盖的"鱗片"。但我們現在知道，这三个特征也正是原始观音座蓮属所以区别于观音座蓮属的一些主要特征，因此他的新属必須被認为是原始观音座蓮属的同义名詞。

早田文藏氏的第二个新属 *Protomarratia* 也是同样不能成立的，虽然曾被 Bower 氏（The Ferns, Vol. II. P. 127）当作一个有效的属看待的。这个属是根据越北的标本建立的，而它的孢子囊羣还在幼年发育阶段，經过干制过程，被压挤得很紧，看起来好象是 *Marratia* 的合生孢子囊羣那样，除此以外，本属的模式种，*Protomarratia tonkinensis* Hayata

与产于同地的 *Archangiopteris tamdaoensis* Hayata 并无不同之点，这早已在 1935 年被 Christensen 和 Tardieu-Blot 两氏指出了 (Lecomte, Not. Syst. 5 卷, 3 頁)。

正如 Bower 氏所評述的那样，*Archangiopteris*, *Protomarratia* 和 *Protangiopteris* 这三个属名的含义是十分令人迷惑的。在它們的創立人的心目中認为这些属在进化上比观音座蓮属 (*Angiopteris*) 和 *Marratia* 属更为原始，但是这些所謂原始蕨属在孢子囊羣的位置上比之更古老的蕨属离叶边更远处向下延伸，而且叶柄及其他部分只有鱗片而无毛——这两点在蕨类植物一般被認为是原始性的一些指标。如果同地質年代早期的化石——例如上泥盆紀的孢子囊羣为边生蓮座形的 Coenopteridaceae 相比，可以証明这些属显然不是比观音座蓮属更为古老，而却由观音座蓮属演化而来的。

长期以来，学者們关于观音座蓮目 (Marratiales) 这羣古老的蕨类究竟是代表一个单系羣的科 (Marratiaceae)，还是应該分立为几个科或者几个亚科的意見，一直是分歧的。Christensen 氏在 1938 年第一次提出了——我認为是恰当的——把这个目分为两个科，即观音座蓮科 (Angiopteridaceae)，包括 *Macroglossum* Copel., *Angiopteris* 和 *Archangiopteris* 三个属，和 Marratiaceae 科，包括 *Marratia*, *Danaea*, 和 *Christensenia* 三个属，他这样做的主要理由是前一科的孢子囊羣是由分离的并且頂部具有不发育的胚带的孢子囊組成的，而后一科的孢子囊羣則由合生的頂端不具不发育的胚带的孢子囊組成的聚合孢子囊羣。与此相反，Copeland 氏 1947 年在蕨綱植物科属志一书中認为 Christensen 氏的做法在系統发育上是沒足够理由能保証的，但奇怪的是他把本目分立为四个亚科，即 Angiopterideae, Marratieae, Kaulfussieae 和 Danaeiae。这种安排实际上同現有的証据是不相符合的。

早在 1940 年我曾确切地提出了把天星蕨属 (*Christensenia*) 分立成为一个单独的科，天星蕨科 (Christenseniaceae)。这样做法的主要理由是它有腹背形的根状茎，掌状叶和网状脉以及圓形的聚合而中空的孢子囊羣不具夹絲。从个体发育研究的結果也証明这样做法是确当的，因天星蕨的孢子世代的第一个幼叶的形体是鏟形，具有网状脉的特点，而观音座蓮，*Danaea* 和 *Marratia* 三个属的孢子世代的第一个幼叶是扇形，具有标准的二叉分歧的分离脉型，即此一点也可以作为支持天星蕨比其他各属在进化上較为后来的一个証据，与此同时，美国 Campbell 氏 (Evolution of Land Plants 第 330 頁) 也不謀而合地建議把天星蕨属分立为独立的科，叫做 Kaulfussiaceae。

現在，如过去一样，我仍坚持我的意見，即多孔蕨属 (*Danaea*) 应該同样地从古老的 Marratiaceae 科里分立成为独立科，Danaeaceae Agardh，这样就使 Marratiaceae 科只剩下合囊蕨属 (*Marratia*) 一个属，因为这两个科在系統发育上是代表着不同的近代路綫的，虽然它們十分可能是起源于大約同一个地質年代。

总結上面的討論，可以把观音座蓮目分为如下四科：

1. 观音座蓮蕨科 (**Angiopteridaeae** C. Chr.) 包括 *Macroglossum* Copel., *Angiopteris* Hoffm. 和 *Archangiopteris* Christ et Gies., 三个属。
2. 合囊蕨科 (**Marratiaceae** Kaulf.) 包括 *Marratia* Swartz 一个属。
3. 多孔蕨科 (**Danaeaceae** Agardh) 包括 *Danaea* Smith 一个属。
4. 天星蕨科 (**Christenseniaceae** Ching) 包括 *Christensenia* Maxon 一个属。

現在討論一下孢子囊羣的进化問題。今日已知的丰富化石資料似乎指出聚合孢子囊

羣不一定是由那些具有分离孢子囊羣的蕨类演变出来的次生变异現象，如同 Bower 氏所訊为的那样，而正如 Scott 氏 (Study of Fossil Botany I. p. 366. 1921)所指出那样，可能起源于地質年代早期的某羣蕨类。这种説法是正符合于实际情况的，因为远在古生代，具有分离孢子囊的孢子囊羣的蕨类（如 *Scolecopteris*, *Eoangiopteris*）和具有合生孢子囊的不同类型的聚合孢子囊羣的蕨类（如乔木型的 *Ptychocarpus* 和 *Asterotheca*）它們已經被发現同时存在的了。我也不同意 Bower 氏 (The Ferns II. p. 110. 1927) 訊为团形类型的聚合孢子囊羣，如同天星蕨那样，是由綫形类型的聚合孢子囊羣通过分裂过程演变的結果，而恰恰相反，我倒訊为孤立的孢子囊羣能通过融合过程轉变为汇合孢子囊羣是蕨类植物在孢子囊羣进化的一般途径。 这种情况在薄囊蕨綱的一些进步的蕨羣特别看得清楚，而孢子囊羣的分裂在这些蕨类与其説成是一般現象则倒不如当作是一个偶然的或者不正常的現象看待。

更有进者，如众所周知，不同进化羣系的生物有机体的某些器官构造的相同，往往可能是趋同发展的結果，而不一定是系統进化上亲緣关系的指标，关于这一点，一般的蕨类植物的一些特征，就是如此，例如孢子囊羣的形体，囊羣盖的有无，这些特征在半世紀以前曾被当时的蕨类植物学家（如英国的 Hooker 和 Baker 氏等）作为蕨类系統分类的基本准繩，而現在则被視为这只不过是次生的而且往往是趋同的結果而已。在这个問題上，天星蕨属的亲緣关系可以追溯至石炭紀的祖先类型，如 *Ptychocarpus* 或是 *Asterotheca*，它們有团形蓮座状的聚合孢子囊羣，而与近代的合囊蕨属 (*Marratia*) 的关系则远較疏远，因为不但它的聚合孢子囊羣是綫形，而且还有許多其他重要形态上的区别。

原始观音座蓮蕨屬的种之检索表

1. 叶下部为二回羽状，羽片 10—12 对，长 15 厘米，寬 2.5 厘米，边緣有齿牙……………………
……………………………………………… 1. **二回原始观音座蓮** *A. bipinnata*

1. 叶全部为一回羽状，有較大和較少的 (1—7 对)羽片。
    2. 羽片有逆行假小脈自叶边向下倒行，位于眞脈之間；孢子囊羣短 (5—6 毫米) 接近于叶边，因此，中肋两側的不育空間远比近叶边的为寬………………………2. **边囊原始观音座蓮** *A. Cadieri*
    2. 羽片不具逆行假小脈；孢子囊羣远較长，位于边叶与中肋之間，因此中肋两側的不育空間几等于近叶边的。
        3. 叶柄基部以上有 4—5 个肉質节状突起，羽片下面被适度的节状毛；孢子囊羣长 3—3.5 厘米，有茸毛状的夾絲密生………………………………3. **河口原始观音座蓮** *A. hokouensis*
        3. 叶柄只有一个肉質节状突起，位于中央以下，羽片下面无毛或者不具前种那样的毛，孢子囊羣一般远較短，夾絲通常短而較疏。
            4. 側生羽片鐮状綫披針形，基部一对比上面一对长約一半，基部均为闊圓形或者亚圓形，叶边全緣……………………………………… 4. **圓基原始观音座蓮** *A. subrotundata*
            4. 側生羽片通常为披針形，基部一对长等于或者仅稍短于上面一对，向楔形基部漸变狹。
                5. 羽片对生或者亚对生，叶边有粗齿牙状的鋸齿；夾絲比孢子囊羣远短并且被复盖不見。
                    6. 羽片为闊倒披針形，有尾状头，叶边自基部向上有齿牙；夾絲极短…………
                    ……………………………………… 5. **尾尖原始观音座蓮** *A. caudata*
                    6. 羽片卵状披針形，有漸尖头，叶边自基部向上有弧曲尖鋸齿；夾絲較长……
                    ……………………………………… 6. **尖叶原始观音座蓮** *A. tonkinensis*

5. 羽片互生，叶边为全緣，至多为波状，或为圓齿形浅波状；夾絲与孢子囊等长或較长。
  6. 羽片为闊卵状披針形，短漸尖头……………… 7. **闊叶原始观音座蓮** *A. latipinna*
  6. 羽片为披針形或倒披針形，緩漸尖头。
    7. 羽片披針形，平坦，全緣或齿牙形波状，草質，产云南东南部及越北。
      8. 羽片 2—4 对，有緩漸尖头，基部对称；孢子囊羣长 1—2 厘米………………………………………………………8. **亨利原始观音座蓮** *A. Henryi*
      8. 羽片 5—7 对，急尾尖头，基部不对称；孢子囊羣长 1 厘米……………………………………………………… 9. **斜基原始观音座蓮** *A. subintegra*
    7. 羽片狹倒披針形，叶边波形圓齿状，浅波状，厚紙質，产台湾……………………………………………………………… 10. **台湾原始观音座蓮** *A. Somai*

1. 二回原始观音座蓮 [图版四十九，1]

Archangiopteris bipinnata Ching, Ic. Fil. Sin. **5**: t. 203. 1958.

叶柄长 60—70 厘米，直径約 4 毫米，腹面有深沟，淡綠色，草質，下部略有紧貼的暗棕色披針形长尖头的鱗片，基部以上約 20—34 厘米处有一个膨大的节，叶体三角状卵圓形，长 40—50 厘米，中部寬約 22 厘米，基部为二回羽状，向上为一回奇数羽状；叶片 10—12 对，基部一对或二对羽片特大，长 16—19 厘米，寬 6—7 厘米，有 2.5—3 厘米长的小叶柄，羽裂为 2—7 对側生小羽片，闊披針形，漸尖，几无柄，开展，并有粗齿牙，长 2—3 厘米，基部以上寬約 1 厘米，圓楔形，頂端小羽片大形，长 7—10 厘米，寬 2.8 厘米；上面的一回羽片有叶柄（长 4—6 毫米），綫状披針形，向頂端漸狹为漸尖头，长 12—17 厘米，近中部寬 2—2.8 厘米，基部圓楔形，叶緣全部具有規則的粗齿牙；叶軸干后压扁，向上端两边有狹翅；頂生羽片与相邻的同形；叶为草質，干后为綠色，除叶軸、中肋下面及叶柄膨大处有一些棕色小鱗片外，全为光滑；叶脉上下两面明显，脉間距离 2 毫米，一般为单脉或分叉，几乎成直角从中肋伸出，直行，达于边緣的每一齿牙；子囊羣綫形，生于上部一回羽片上的，长約 5 毫米，由近中肋向外伸展到距叶緣 4 毫米处，沿生单脉上或分叉脉上，由 20—40 个孢子囊組成，在孢子囊羣下面有許多密生分枝的夾絲，长等于或稍过于孢子囊，生于小羽片上的子囊羣較短，由 10—12 个孢子囊組成，从小中肋出发几达边緣；孢子暗色，透明，圓而有稜角，表面有粗疣状突起。

产地：云南东南部，馬关县，金口（老君山），馮国楣 *13679*，1947 年 11 月 7 日，生杂木林下，少見，拔海 1,100—1,300 米。

本种为本屬中最特殊的种，一般体形酷似观音座蓮；在原始观音座蓮屬中发现二回羽叶的种是有很大意义的，因为由这一种的发現，在一定程度上改变了过去对屬的界説，打破了过去总是認为一回羽叶为本屬的特征之一的传統看法。

2. 边囊原始观音座蓮

Archangiopteris Cadieri Tard. et C. Chr. in Lecomte, Not. Syst. **5**: 8. t. 1. fig. 1—2. 1936; in Fl. Gen. Indo-chine **7**: 15, 1939.

产安南的 Cua Tung，拔海 50—100 米的山林。

本种是安南的特有的和特出的种，它不同于本屬的其他之种在于如同观音座蓮屬的一些一样有长約 1 厘米的逆行假小脉一条，位于每对眞脉之間，从叶边向下倒行，这个特

征在原始观音座蓮属中为前所未見。本种另一特征为其較短的由大約30—50个組成的孢子囊羣，向外到达离叶边不远处，向內则止于离中肋很远处，因而在中肋两側留下很寬的不育空間，这样就使本种在外观上頗象观音座蓮。因此，本种似为在亲緣关系上极相近的原始观音座蓮属与观音座蓮属之間的中間型。

3. 河口原始观音座蓮 [图版四十九，2]

Archangiopteris hokouensis Ching, Ic. Fil. Sin. **5**: t. 240. 1958.

根状莖粗大，肉質，亚直立，直径3—4厘米，下面具鉄絲状的厚肉質的黑色单根；叶簇生，柄长达50厘米，厚达5毫米，肉質，綠色，有4—5个膨大具沟槽而干后为黑色的节状突起，各节間的距离大致相等，另外被有一些卵状披針形而基部为圓心脏形的深棕色鱗片，边緣有长鋸齿；叶体为寬卵形，长达30厘米，寬約38厘米，一回奇数羽状，頂端小羽片較大，长20—22厘米，寬7—9厘米；小羽片2—3对，同形，对生或亚对生，节距5—6厘米，长15—20厘米，中部寬5—7厘米，闊橢圓披針形，有小柄，长約1.5厘米，膨大，淡黑色，略具鱗片，頂部为短尾状漸尖头幷具粗鋸齿，向基部漸狹，成楔形，边緣有波状浅齿或波状齿牙；叶为紙質，上面深綠，下面淡綠，幷有相当多的节状細毛复盖；叶脉細长頗开展，明显，大都分叉，間为单一，近叶边向上弯弓，幷深入鋸齿；子囊羣綫形，长3—3.5厘米或較长，彼此頗接近，由160—240个子囊成二列組成，不育边緣和中肋两側寬达5毫米，夹絲綫形，稠密，节状分枝，由10—15个細胞組成，长过于子囊；孢子短圓形，透明，具密集的小刺状突起。

产地：云南东南部的河口，南溪鎮，朱維明 *1726*，1955年7月，生于潮湿浓蔭的林下沟中，拔海150米，普通。

本种为本属一个独特的种，其叶柄在基部以上具有4—5个节状膨大，小叶很寬，橢圓披針形，边緣有波状鈍鋸齿，下面密生节状毛，子囊羣极长，幷具很长的密毛茸状的夹絲，几乎完全复盖着初生的子囊羣。

4. 圓基原始观音座蓮 [图版五十，1]

Archangiopteris subrotundata Ching, Ic. Fil. Sin. **5**: t. 206. 1958.

叶柄长36—60厘米，淡綠色，腹面有深沟，有淡紅棕色的綫形鱗片，尤以下部为多，边緣有睫毛，基部以上20—30厘米处有膨大的节；叶体长与寬各約40厘米，闊卵形，奇数羽状；羽片4—6对，頂生羽片与側生的同形，互生，相距約4厘米，有小叶柄(柄长7毫米，膨大)，基部一对甚短，(长14厘米)，鐮刀状，向上弯弓，与上部的同形，基部圓形，上部羽片长22—25厘米，中部寬5厘米，闊綫状披針形，漸尖，基部几不变狹，圓形或亚圓形，不呈楔形，叶全緣或至多略呈波状，頂端有鋸齿；叶为薄草質，綠色，除中肋有鱗片疏生外，均为光滑；叶脉开展，明显，相距4毫米，单脉或分叉，近边緣显然向上弯弓；孢子囊羣綫形，一般长8—12毫米，相距甚远，位于叶緣与中肋之間，两端有等寬的不育空間，有密生分枝的节状夹絲，长过于孢子囊；孢子长圓腎形，有細密刺头突起，透明。

产地：云南东南部，西疇县，馮国楣 *12019*，生杂木林下，拔海1,500—1,600米。

本种形体頗似亨利原始观音座蓮(*A. Henryi* Christ et Gies)，但羽片不为披針形而为闊平行状披針形，下部的为鐮刀状，基部的羽片远較上部的为短，边緣为全緣，或在頂端以下有时为波状，向圓形或亚圓形的基部不为明显的变狹。

5. 尾叶原始观音座蓮 [图版五十，2]

Archangiopteris caudata Ching, Ic. Fil. Sin. **5**: t. 208. 1958.

根状茎亚直立，粗达2厘米，有粗根，叶柄长30—45厘米，直径3—4毫米，綠色，几无鳞片，在基部以上30厘米处有膨大的节；叶体为卵形，长30厘米，寛約25厘米，奇数羽状；羽片在所見标本为2对，亚对生，相距5—6厘米，頂生羽片稍較大，长16—18厘米，中部寛4.5—5厘米，側生羽片皆为同形或基部一对微較短，闊倒披針形，向楔形的基部漸变狭，頂部突变为尾状（尾头长約1.5厘米，綫形，有鋸齿），叶边自基部以上有粗齿牙；叶为草紙質，綠色，上下两面光滑，但沿中肋及叶脉有小披針形鱗片疏生；叶脉亚开展，与中肋成60°的上角，大多数分叉，或单脉，近叶緣向上弯弓而达于鋸齿；子囊群长8—10毫米，离中肋及叶边各約6毫米，亚近生，由40—70个子囊組成，少有更多的，托稍隆起，夹絲远較子囊为短，紅棕色，节状，由基部分枝很多；孢子球圓形，具細密刺头，透明。

产地：广西南部，明江，千牛山，前广西大学生物系采，生半山以上的林内沟中。

本种是一明显的地方种，其不同于亨利原始观音座蓮者为其倒披針形的羽片突成尾状头，叶边具粗齿牙，和子囊群的夹絲非常短，而由基部分枝繁密，不易由上方見到。

6. 尖叶原始观音座蓮 [图版五十一，1]

Archangiopteris tonkinensis (Hayata) Ching, Ic. Fil. Sin. **5**: t. 209. 1958.

叶柄长40—45厘米，淡綠色，腹面有寛沟，有疏生披針形棕色而有齿牙的鱗片，下部較多，基部以上20—30厘米处有膨大的节；叶体闊卵圓形，远短于叶柄，奇数羽状，頂生羽片有长柄，与側生的同形，側生羽片2—4对，对生，斜出或斜开展，卵状披針形，长20—25厘米，寛4—5厘米，有小叶柄（叶柄长約5毫米，膨大，干后近黑色），中部最寛，向两端漸狭，頂端为长漸尖，基部短楔形，叶緣有弧曲形尖鋸齿；叶多少为厚堅紙質，腹面光滑，无毛，背面沿中肋有疏生鱗片；叶脉甚开展，很明显，分叉或单脉，向上弯弓，直达鋸齿；孢子囊群长7—10厘米，綫形，位于叶緣与中肋之間，細密而分枝的节状夹絲短于孢子囊，易脱落；孢子长圓形，有微小密刺头突起，透明。

分布：海南島，越南。

本种頗似亨利原始观音座蓮（*A. Henryi* Christ et Gies.），但叶柄远較叶体为长（約两倍），羽片卵状披針形，对生，边緣具有規則的弧曲鋸齿，夹絲远短于孢子囊，故易区别。

7. 闊叶原始观音座蓮 [图版五十一，2]

Archangiopteris latipinna Ching, Ic. Fil. Sin. **5**: t. 207. 1958.

叶柄47—55厘米，直径5毫米，腹面有深沟，下部鱗片頗多，基部以上約20厘米处有膨大的节；叶体卵状长圓形，长35—45厘米，寛26—30厘米，奇数羽状；羽片2—3对，互生，相距4—5厘米，斜出，基部一对較短于上部的，鐮刀状向上弯弓，上部羽片长20厘米，寛5—5.5厘米，中部最寛，闊卵状披針形，向下漸狭为楔形基部，頂端为短漸尖或为漸尖头并有鋸齿，叶全緣或多少为微波状；小叶柄长1厘米，略为膨大，几无毛；叶为厚紙質，上下两面光滑，惟沿叶軸和中肋下面有一些鱗片；叶脉疏松，开展，单脉或分叉，近叶緣向上弯弓，明显；孢子囊群长1—1.5厘米，位于叶緣与中肋之間，相距叶緣与中肋各約7毫米，列間有較寛間隙，夹絲密生，略短于孢子囊；孢子亚圓形，有密生微小疣状突起。

产地：云南东南部，屏边县，蔡希陶 *60299*，生林下，拔海1,200米。

本种表面上頗似亨利原始观音座蓮（*A. Henryi* Christ et Gies.），并曾被認为同种，但叶为厚紙质，羽片远較寬，边緣呈微波状，基部一对显然为鐮刀状和子囊羣的間距較寬。

8. 亨利原始观音座蓮

Archangiopteris Henryi Christ et Gies. in Flora **86**: 72—85. Fig. 1—5, 1899; Christ in Bull. Herb. Boiss. **7**: 14. 1899; Hu et Ching, Ic. Fil. Sin. **1**: t. z. 1930.

根状茎亚直立，直径 2—3 厘米，肉質，有肉質粗健而光滑的長根，除頂端略有鱗片外，余均光滑；叶簇生，叶柄長 40—60 厘米或較長，粗約 2.5 毫米，上面通体有寬沟槽，綠色草質，中央稍下处有节状膨大，有相当多的鱗片，尤以向基部为甚，鱗片狹披針形，長而棕色或深棕色，質薄，宿存，叶体長等于叶柄，寬約 17 厘米，卵形，一回羽状；羽片 2—4 对，頂端一枚同形而較大，有时长达 30 厘米，寬达 6.5 厘米，側生羽片互生，斜出，彼此分开約 5—6 厘米，有小柄，基部一对稍短，長 12—15 厘米，寬約 3 厘米，上面一对長約 17—20 厘米，中部最寬約 4—5 厘米，闊披針形，緩漸尖头，基部楔形，向下漸变狹，小柄長約 1 厘米，膨大，有鱗片，干后变黑色，叶边全緣或略为波状，但向頂部有急尖的鋸齿；叶脉細而疏生，大約 1 厘米內有 4 条，极为开展，两面明显，大都分叉，但也往往分叉脉与单脉相間，向頂部变尖細而向上弯弓，几达于叶边，草質，干后綠色，两面光滑，惟叶下面的中肋有棕色狹披針形鱗片疏生；子囊羣綫形，通直，長 10—20 毫米，被等寬的間隙分开，由 60—160 个孢子囊羣組成，位于中肋与叶边之間，有細而紅褐色的节状分叉夹絲密生，長过于孢子囊羣。

本种为本属的模式种，特产云南东南部屏边县，河口，麻栗坡山地林下。

本种的主要特点为其披針形的互生的羽片，向頂端为有鋸齿的緩漸尖头，向基部为漸狹楔形，有長約 1 厘米的小柄，边緣为全緣或至多有波状齿牙，孢子囊羣下的夹絲幼时为毛茸密生，長过于孢子囊。

9. 斜基原始观音座蓮

Archangiopteris subintegra Hayata in Bot. Gaz. **67**: 90. fig. 1. 1919.

叶柄長达 70 厘米，近基部有披針形的基部为圓形的鱗片，叶体倒卵形，一回奇数羽状：羽片 5—7 对，披針形，長 20—25 厘米，寬 3—5 厘米，向頂部急变为綫形漸尖头，長約 2—3 厘米，基部为不等形，小柄長約 7 毫米，膨大有鱗片，叶边亚全緣或波状，叶質薄；孢子囊羣長 1 厘米，位于中肋和叶边之間，有夹絲疏生，長过于孢子囊。

本种产于越北的 Chapa 与 Muong Xen 及 Ta Phinh 一带，靠近云南东南部边境的林下。可能是前种的一个变型。

10. 台湾原始观音座蓮　[图版五十二]

Archangiopteris Somai Hayata, Ic. Pl. Form. **5**: 256, 1915; **6**: 154, fig. 60 t. 19. 1916; Ching, Ic. Fil. Sin **5**: t. 205. 1958.

叶柄長 50—60 厘米，有疏生鱗片，尤以下部为多，基部以上約 25 厘米处有膨大的节；叶体長卵圓形，奇数羽状，羽片 2—3 对，頂生羽片与下部的同形，長 20 厘米，寬 4 厘米，为微倒披針形，中部以下漸狹，基部略为寬楔形，頂端漸尖，尾状，長 3—4 厘米，互生，有小叶柄（柄長約 1 厘米），叶緣浅波状，基部以上有不規則的圓齿状齿牙；叶为厚草質或坚紙質，干后棕色，几无毛；叶脉頗开展，单脉与分叉脉相間；孢子囊羣綫形，長 1.5 厘米，位于中部，中肋两边及叶緣下面为不育空間，夹絲短于孢子囊，隐匿，从表面不易見到；孢子圓形

或长圆形，頗微小，具疣状突起，透明无色。

产地：台湾特产。

本种为台湾南部，中部及北部高山森林中一种很普通的蕨类，幷与云南东南部的亨利原始观音座蓮（*A. Henryi* Christ et Gies.）頗相似，但因羽片为厚草質，长倒披針形，有圓齿状齿牙和叶緣为浅波状，故有不同。

A REVISION OF THE FERNS GENUS *ARCHANGIOPTERIS* CHRIST & GIESENHAGEN*

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(Abstract)

Ample paleontological evidences brought to light within last few decades have revealed in a convincing manner that the group of ferns known as *Marratiales,* though apparently now no longer in a very active state of evolution, is a very primitive group of ferns and that the existence of Marratiaceous type of plants is a very ancient one with its origin and historical development dated back to the Upper Palaeozoic Period, at which time a number of fossil forms such as *Scolecopteris, Asterotheca,* etc., found in all continents, distributed as far north as 70°N. Lat. show great similarity in regard to anatomical structure and soral character to the living representatives of the group now growing only in regions below 30° N. Lat. (for example, the Mt. Omei in Szechuan Province, West China). Although plants with arborescent stem (up to 10 m high, as *Asterotheca arborescens*) and fern-like fronds bearing sori similar to those of the existing Marratiaceous ferns are found as early as in the Upper Palaeozoic flora, it is in the older Mesozoic rocks that we first encounter ferns which agree closely in habit and soral character with the recent representatives of the group. The maximum development of these ferns which seems to have been begun by the end of Carboniferous, extended throughout Permian to Pre-cretaceous time, represented, as is now known, by over 30 extinct genera, which constituted not only widely dispersed but also one of the dominant elements in the vegetation of those times. In fact, the modern *Marratiales* are among the only living ferns which can be definitely associated with the oldest known fossil ancestors.

To-day, of this vast ancient group of plants once of very wide distribution, there remain only 6 pan-tropical genera, assignable, in my opinion, to possibly 4 distinct families (see below) still widely dispersed in the tropics of both hemispheres, namely, *Angiopteris* in the eastern, *Danaea* in the western and *Marratia* in both, with one Malaysian species (*M. sambucina* Bl.) extending northwards to Cochin-China (Annam), and *Macroglossum* and *Christensenia* in the Malaysian region, the latter extending to the mainland of tropical southeastern Asia, while the interesting genus *Archangiopteris* in its present distribution endemic in a comparatively small area on the Yunnan-Tonkin borderland. This ancient group of plants, as is known to-day, was not directly involved

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in the evolution of the advanced types of living ferns and its present-day survivers still remain practically at the same stage of evolution as their ancestors of many million years ago. Among extent modern ferns no other group of comparable antiquity exists except *Ophioglossaceae* which though nearly as primitive as *Marratiales,* have not yet been definitely associated with Palaeozoic fossils.

Before we go further in our discussion, it may be well to point out that of the Marratiaceous type of modern ferns only two genera, *Angiopteris* and *Archangiopteris,* had been known to occur in the tropical and subtropical parts of China until 1956, when the discovery of *Christensenia* in the southeastern part of Yunnan added a third genus of the group to the fern flora of this country. This note-worthy addition is represented by *C. assamica* (*Kaulfussia assamica* Griff.) Ching, comb. nov. previously known only from Assam, Northern India, but erroneously considered in the past as being identical with the Malaysian *C. aesculifolia* (Bl.) Maxon, from which the species from the Asiatic mainland differs in many respects.

In the present paper, we are primarily concerned with the genus *Archangiopteris,* which up to now was yet imperfectly understood as regards its origin, morphology, taxonomy and geographical distribution.

As far as the fossil remains go, it seems beyond doubt that the prototype of *Archangiopteris* dates back to the time of Coal Measures, typified by a fossil plant known as *Danaeopsis fecunda* Halle from the Rhaetic coal mines of Billecholm, which, in spite of the implications of its name, conforms very closely to the genus *Archangiopteris* in the lanceolate pinnae and the long linear superficial sori consisting of two close rows of separate sporangia each dehiscening down by a ventral longitudinal slit, differing only in dichotomous lateral veins with reticulated intermediate veinlets, a condition perhaps due to the broadening of the webbing.

Phylogenetically, *Archangiopteris* represents the topmost twig of one of the evolutional lines of the ancient Marratiaceous type of ferns, and its relation with *Angiopteris* is so close that it may with good reasons be considered as a direct descendant, although in the course of evolution through great geologic ages, acquired a series of characters significant enough to warrant its segregation as a distinct though closely related genus.

Geographically, this peculiar genus has now a restricted distribution, being confined to a rather narrow strip of earth surface of a mountainous nature, between 19—24° N. Lat. and 106—122° E. Long., where still exists a remnant of a more or less luxuriant tropical monsoon forest, in which the genus *Angiopteris* also flourishes as well as *Christensenia assamica* (Griff.) Ching of the same group discovered there two years ago for the first time in China. Considering the number of species now known, it may be safely inferred that the southeastern Yunnan-Tonkin region might be the original home of *Archangiopteris.* This area, characterized by comparatively stable tropical climatic conditions in the historic past coupled with complicated land features, seems to be a centre of distribution for many descendants and survivors of ancient tropical elements, some of which seem to have continued to develop into new forms as exemplified by *Archangiopteris* among the Filicales (Fig. 1, p. 202).

The genus *Archangiopteris* of the family *Angiopteridaceae* Carl Christensen, once placed in Marratiaceae by all other authors, ever since its founding by Christ and Giesenhagen in 1899, has been a subject of much morphological and phylogenetical interest, but remained imperfectly known owing to the scarcity of fresh material available for study. Since then four additional species—three from Indo-China on the Chinese borderland, another from Taiwan—have been ascribed to this what had been previously considered a monotypic genus. However, among collections made by

Chinese botanists during the last twenty years in southeastern Yunnan and on the Island of Hainan, five more species have been recognized, bringing the total number of species now known in the genus up to ten, at the same time, extending its geographical range from southeastern Yunnan through the southern part of Kwangsi Province to the Islands of Hainan and Taiwan. In this connection, it may be pointed out that the chief significance of these new discoveries lies not so much in the number of species increased, as in the revelation of an array of new characters of morphological and taxonomical importance, which combined contribute materially to a far better understanding of the genus as a whole. Among the new characters brought to light by my recent study, mention may be made of the following:

1) One of the diagnostic characters heretofore ascribed to *Archangiopteris* has been the "simply pinnate frond", by which the genus is distinguished from *Angiopteris*, as has been generally reiterated in current botanical literature. But since the discovery of a bipinnate-leaved species, *Archangiopteris bipinnata* Ching from southeastern Yunnan, this character no longer holds good, although simply pinnate fronds still remain to be a predominant feature of the genus.

2) It has long been known that the sori of *Archangiopteris* are usually provided with paraphyses called "fringed scales", or "false indusium" by authors in the past. However, the result of my study makes it evident that the paraphyses under the linear sori in *Archangiopteris* are not scales at all but really hairs, and their presence in the genus is not only constant but also affords a reliable character in specific diagnosis. The paraphyses consist of rod-like or cylindrical multicellular articulated hairs of varying length, sometimes more or less glandular at the apex, always freely branched from close to or above the base, and varying in length with different species. In most species they are usually as long as the sporangia, but in others, for example, *A. caudata* Ching from southern Kwangsi, they are so short as to be completely hidden underneath the sori, so that when seen from above, the sori appear as if exparaphysate (without paraphyses), while in another species, *A. hokouensis* Ching from Hokou, Yunnan, the paraphyses are decidedly longer than the sporangia, composed of up to 15 cylindrical septate cells, so densely crowded along the soriferous veins that the young developing sori virtually appear to push their way upwards from underneath the thick coating of long shaggy hairs.

3) The stipe of *Archangiopteris*, like that of *Danaea*, has been noted as being always provided with a single geniculated fleshy nodose swelling some distance above its base, or rather below its middle; and this is generally true of all the previously known species, but in the newly discovered *A. hokouensis* Ching, 4—5 such nodose swellings all spaced at fairly regular intervals occur along the entire length of the stipe, so that it looks somewhat like a bamboo culm in general appearance. It has been pointed out (Тахтаджян, Высшие растения I. 184, 1956.) that the characteristic nodose swelling on the stipe or petiole, actually an air-inflated joint full of sappy substance, is of considerable physiological significance in the life of modern Marratiaceous ferns in as much as it is suppose to, as it actually does, serve as an effective mechanism for controlling the orientation of leaves in relation to the direction and intensity of sunrays falling upon them.

4) Another outstanding character distinguishing *Archangiopteris* from *Angiopteris* is the very long linear superficial sori which are composed of usually 40—60, sometimes up to 160 sporangia, medially situated along the veins. However, in the new species, *A. hokouensis* Ching, the sori measure up to 3—3.5 cm in length and consist of up to 240 sporangia.

5) In the past, The so-called spurious "recurrent veinlets" running downwards from the margin between each pair of true veins were not known to exist in *Archangiopteris*, but in *A. Cadieri* Tard. et C. Chr., a species discovered not long ago in Annam, the presence of "recurrent

veinlets" do occur. Moreover, in this species the rather short (3—4 mm) linear sori with 35—50 sporangia occupy a position nearer to the leaf-margin than to the costa of the pinnae very much in the same manner as in some species of *Angiopteris*. These two characters may be considered as additional evidence to support the view that *Archangiopteris* is a direct derivative from *Angiopteris*.

In spite of the fact that many important new characters of morphological significance have been revealed by the recent study of ample material in hand, through which some of the previously accepted distinctions between *Angiopteris* and *Archangiopteris* seem to have been greatly weakened, if not altogether broken down, the distinction between the two closely related genera still remains real and unmitakable, substantiated as it is by other new characters of even greater significance. In order to clarify the prevailing but quite misleading conception of the genus under review, a revision of the generic diagnosis and revaluation of the distinctions between *Archangiopteris* and *Angiopteris*, as far as our present knowledge goes, seem much to be desired.

Archangiopteris Christ et Gies. in Flora **86**: 72—85, 1899; Diels in Engl. u. Prantl, Nat. Pflanzenfam. **1**: iv. 439. 1899; C. Chr. Ind. Fil. 62. 1905; Suppl. III. 26. 1936; Tard. et C. Chr. in Lecomte, Not. Syst. **5**: 5. 1935; in Fl. Gen. Indo-chine **7**: 14. 1939; Cop. Gen. Fil. 15. 1947.

Protomarrattia Hayata in Bot. Gaz. **67**: 88, fig. 1. 1919.

Protangiopteris Hayata in Bot. Mag. Tokio **42**: 308. 1928.

Medium-sized terrestrial ferns inhabiting tropical mountain forests of evergreen broad-leaved trees. *Rhizome* rather elongate, suberect or oblique, dorsiventral with a few long unbranched incrassate fleshy roots; *fronds* fasciculate, several together, stipe long, rather slender, fleshy-herbaceous, broadly grooved above throughout the rachis, copiously clothed especially in the lower part in long, linear, coarsely dentate, dark brown, clathrate and peltately affixed thin scales and provided at the base with a pair of quite large fleshy, ovate-oblong persistent stipular appendages and upward with one or sometimes 4—5 geniculate fleshy nodose swellings which become collapsed and blackish upon drying; lamina ovate to deltoid, shorter than stipe. As a rule, simply impari-pinnate, or rarely bipinnate, generally with 1—6 pairs of alternate or subopposite, broadly lanceolate, acuminate, petiolate *pinnae* below a similar but usually larger free terminal pinna, petioles also inflated and turning blackish when dry; *venation* free, veins obliquely patent from the costa, once-forked above the base, or simple, distinct, extending from the costa to near the leaf margin with more or less antrorsely curved and attenuate apice, as a rule, without spurious recurrent veinlets (except in *A. Cadieri*); *texture* herbaceous or chartaceous, green, glabrous above, rachis and underside usually sparsely scaly; *sori* linear-elongate, dorsal on the veins, as a rule situated midway between the costa and margin, leaving a broad sterile space on each side of costa and along the margin, consisting of a great number (20—60—160—240) of boat-shaped free sessile sporangia having rudimentary annulus at the apice in two opposite close rows, opening down the ventral side by a longitudinal slit, and provided underneath with numerous, long or short, articulate, subglandular, transluscent and branched hair-like paraphyses, easily abraded upon drying; *spores* roundish to broadly ovoid, yellowish-white, transluscent with dense, short, fine echinoses (exospores).

A natural genus of about 10 species in Yunnan-Tonkin border extending from Southwest China eastwards to the southern part of Kwangsi and the islands of Hainan and Taiwan.

Without doubt, the genus is closely related to *Angiopteris*, from which it is technically distinguished by much smaller, simpler and slender habit having rather elongate, suberect dorsiventral rhizome with thin-fleshy ovate-oblong bivalved persistent stipules at the base of the slender stipe, which is always provided at about 20 cm or higher up above the base with one, or sometimes more, fleshy nodose swellings turning blackish upon drying; by the presence especially in the

lower part of the stipe of rather copious, linear-elongate, clathrate, coarsely dentate and peltately affixed scales; by the much smaller and simpler lamina, which, as a rule, is simply impari-pinnate (rarely bipinnate) with a few pairs of much larger and broadly lanceolate pinnae each provided with a fairly long and inflated petiole; by longer linear sori consisting of more numerous sporangia (generally 40—240), not inframarginal but situated midway between the costa and margin and provided underneath with numerous, articulate and freely branched hair-like paraphyses, and finally by finely echinose spores.

After the recognition of the genus *Archangiopteris* by Christ and Giesenhagen in 1899, then known only from the southeastern corner of Yunnan Province, China, the generic concept was greatly confounded by Hayata, who in a period of some ten years proposed two new genera, namely, *Protomarratia* and *Protangiopteris* based upon specimens from Tonkin and Taiwan. While establishing the genus *Protangiopteris,* apparently without an intimate knowledge of *Archangiopteris* Christ et Gies., Hayata designated, as the basis of his new genus, what he thought to be three distinctive characters, namely, the presence of an inflated articulation below the middle of the stipe, the non-inflated petiole of the pinnae and the presence of numerous "scales" as false indusia underneath the sori, but, as we know now, these three characters are exactly some of the chief diagnostic distinctions of *Archangiopteris* from *Angiopteris* and, therefore, his genus must be regarded as a synonym of *Archangiopteris* Christ et Gies.

The same is also true of *Protomarratia* Hayata. The genus, though accepted as valid by F. O. Bower (The Ferns Vol. II. p. 127), was based upon specimens from Tonkin with the young developing sori so crashed upon drying that they appeared to be composed of coherent sporangia (synangium) as in *Marratia,* otherwise his *Protomarratia tonkinensis,* type of the genus, differs in no respect from *Archangiopteris tamdaoensis* Hayata from the same region, as has already been pointed out by Christensen and Tardieu-Blot (Lecomte, Not. Syst. **5**: p. 3, 1935).

As was already commented upon by Bower(l. c. p. 122), the names of *Archangiopteris, Protomarratia* and *Protangiopteris* are very misleading in their implications. For in the mind of their authors, these genera are supposed to be more primitive than both *Angiopteris* and *Marratia.* But these assumed primitive ferns actually have sori more extended down the margin of pinnae than those of the older genera and bear scales on stipe and other parts instead of hairs, which both have generally been considered as some of the indications of primitiveness in ferns. A comparison with early fossils such as the Upper Devonian *Coenopteridaceae,* where the sori are rosette-like and marginal, clearly indicates these genera are no older than *Angiopteris* at all, but rather its derivatives.

Authors in the past have long been divided in their opinions as to whether the modern Marratiales should be represented by a single family *Marratiaceae,* or else be divided into several families or subfamilies. Carl Christensen (in Verdoorn, Manual of Pteridology pp. 527, 528. 1938) was the first to propose, and I think appropriate, to divide the order into two families, namely *Angiopteridaeceae* and *Marratiaceae,* on the chief ground that the former has sori consisting of free sporangia which are provided with rudimentary annulus at the apice, while the latter has synangial sori of coalescent sporangia not crowned by a rudimentary annulus. On the other hand, Copeland (Gen. Fil. p. 14. 1947) thought this is not warranted on phylogenetical grounds, and he devided the order into four subfamilies, namely, *Angiopterideae, Marratieae, Kaulfussieae* and *Danaeiae,* a disposition not compatible with evidences now available.

Early in 1940 I actually proposed to segregate the genus *Christensenia* as a family, *Christenseniaceae* (Bull. Fan Mem. Inst. Biol. Bot. Ser. **10**: p. 227. 1940) for the chief reason that it

has dorsiventral rhizome with digitate fronds, reticulate venation and circular synangia with a hollow in the centre but without paraphyses. The results of ontogenetic studies also confirmed this decision, since the first young sporophytic leaf of *Christensenia* is spade-like in outline characterized by reticulate venation, while that of *Angiopteris, Danaea,* or *Marratia* is fan-shaped with typically dichotomous free venation. This may also serve as a evidence, which tends to support the general belief that *Christensenia* is of a late descent in evolution as compared with other related genera. At about the same time, Campbell (Evolution of Land Plants p. 333, 1940) also suggested the segregation of *Christensenia* into a distinct family (*Kaulfussiaceae*).

I am still strongly of the opinion as I was long ago, that *Danaea* should likewise be separated from *Marratiaceae* into an independent family, *Danaeaceae* Agardh (Aphorismi Bot. p. 117. 1822, pro parte), thus leaving the genus *Marratia* in a family of its own, for phylogenetically these two families represent distinct lines of evolution, although originated in all probability about the same geological time.

Summing up the above stated, it seems quite logical to divide the old comprehensive but very incongruent family *Marratiaceae* into four natural families, as follows:

1. **Angiopteridaceae** C. Chr. including three genera, *Macroglossum* Copel. *Angiopteris* Hoffm. and *Archangiopteris* Christ et Gies.
2. **Marratiaceae** Kaulf. with a single genus, *Marratia* Swartz.
3. **Danaeaceae** Agardh with a single genus, *Danaea* Smith.
4. **Christenseniaceae** Ching with a single genus, *Christensenia* Maxon.

Ample fossil remains seems to suggest that the cohesion of sporangia to form synangia was not necessarily a secondary modification derived from the ferns with free sporangial sori as was thought by Bower, but, as pointed out by Scott (Study of Fossil Botany I. p. 366. 1921), may have been originated in certain groups at very early period; and this is what actually took place, for even in Palaeozoic Times, ferns both with free sporangial sori as seen in *Scolecopteris, Eoangiopteris* and those with synangia of various forms represented by such tree-like ferns as *Ptychocarpus* and *Asterotheca* have been found in contemporaneous existance. Nor do I agree with Bower (The Ferns II. p. 110. 1927), who considered the circular type of synangia as exhibited by *Christensenia* is a result of modification by fission of linear type of sori, but, on the contrary, I am of the opinion that the fussion of isolated sori into coenosori seems to be the general course of evolution among ferns; and this is particularly apparent in some of the advanced groups of Leptosporangiate Ferns, while fission of sori in these ferns may be considered as a casual or abnormal rather than a general phenomenon. Furthermore, the similarity of a certain organ in different groups of organisms, as is well known, may often really be the result of convergent development and not necessarily an indication of phylogenetic relationships. This is particularly true of such characters in ferns at large, as soral conditions and the presence or absence of indusia in the sori, which were taken by elder pteridologists such as Hooker and Baker over half century ago to be basic criteria for classification of ferns. In this connection, it may be inferred, that the phyletic affinity of *Christensenia* may be traced back to such ancestral types as *Ptychocarpus,* or *Asterotheca* of Carboniferous Period with rosette-like synangia rather than to *Marratia* of modern times, which has linear synangia, besides some other important morphological differences.

Key to the Species of Archangiopteris

1. Fronds bipinnate in the lower part, pinnae 10—12 pairs, 15 cm long, 2.5 cm broad,

dentate ··· 1. *A. bipinnate*

1. Fronds always simply pinnate with much larger and fewer (1—7 pairs) pinnae.
   2. Pinnae with one spurious recurrent veinlet running from the margin downward between each pair of true veins; sori short (5—8 mm), situated much nearer to the margin of the pinnae than to the costa, with the sterile space on each side of costa broader than that along the margin ······································ 2. *A. Cadieri*
   2. Pinnae devoid of spurious recurrent veinlets as above, sori much longer, situated midway between the margin and costa, with the sterile space along the costa almost equal to that along the margin.
      3. Stipe with 4 or 5 fleshy nodose swellings above the base; underside of pinnae moderately hairy, sori 3—3.5 cm long, densely paraphysate with long shaggy hairs ·· 3. *A. hokouensis.*
      3. Stipe with only one fleshy nodose swelling below the middle; underside of pinnae glabrous or without similar hairs, sori generally much shorter, paraphyses usually not so dense and shorter.
         4. Lateral pinnae falcately linear-lanceolate, the basal pair about half as long as those next above, all with broad and rounded, or subrounded base; margin entire ·· 4. *A. subrotundata*
         4. Lateral pinnae generally lanceolate, the basal pair as long as, or somewhat shorter than those next above, gradually narrowed towards the cuneate base.
            5. Pinnae opposite or subopposite, coarsely dentate-serrate along the margin; paraphyses much shorter than and hidden by the sporangia.
               6. Pinnae broadly oblanceolate with caudate apice, dentate along the margin from the base upward; paraphyses very short ································ 5. *A. cuadata*
               6. Pinnae ovate-lanceolate with acuminate apice, rather arcuately serrate along the margin from the base upwards; paraphyses longer ································ 6. *A. tonkinensis*
            5. Pinnae alternate, with entire, or at most undulate, or crenato-undulate margin; paraphyses as long as, or longer than sporangia.
               6. Pinnae broadly ovate-lanceolate, shortly acuminate towards the apice ································ 7. *A. latipinna*
               6. Pinnae lanceolate or oblanceolate, gradually longacuminate towards apice.
                  7. Pinnae lanceolate, margin plane, entire or dentate-undulate, texture herbaceous; species from S. E. Yunnan and Tonkin.
                     8. Pinnae 2—4 pairs with gradually acuminate apice; base symmetrical; sori 1—2 cm long ·············· 8. *A. Henryi*
                     8. Pinnae 5—7 pairs with abruptly caudate apice, base oblique; sori 1 cm long ································9. *A. subintegra.*
                  7. Pinnae narrowly oblanceolate, margin undulatecrenate, repand, texture chartaceous, species from Taiwan ·············· 10. *A. Somai*

1. Archangiopteris bipinnata Ching, Ic. Fil. Sin. 5: t. 203. 1958. Pl. XLIX, 1.

Stipe 60—70 cm long, about 4 mm across, deeply grooved above, pale green, herbaceous, sparsely

clothed in the lower part in dark brown, lanceolate, acuminate appressed scales and provided with one nodose swelling at about 20—34 cm above the base; *lamina* deltoid-ovate, 40—50 cm long, about 22 cm broad at the middle, bipinnate at base, simply impari-pinnate upward; *pinnae* 10—12 pairs, the basal 3—4 much the largest, about 5 cm apart, oblique, alternate, petiolate; basal pinnae 16—19 cm long, 6—7 cm broad, on petioles 2.5—3 cm long, pinnate with 2—7 pairs of small, broadlanceolate, acuminate, sessile, patent, coarsely dentate lateral *pinnules* 2—3 cm long, below 1 cm broad above the round-cuneate base, terminal pinnule large, 7—10 cm long, to 2.8 cm broad; the upper simple pinnae on petioles 4—6 mm long, linear-lanceolate, gradually long-acuminate, 17—12 cm long, 2—2.8 cm broad near the middle, base round-cuneate, margin from base to apex regularly and prominently dentate; rachis compressed when dry, very narrowly winged on each side towards the apex; *veins* distinct on both sides, about 2 mm apart, generally simple or forked from above the base, diverging almost at a right angle to the costa and run straight towards the margin into each tooth; *texture* herbaceous, drying green, glabrous except for a few small brown scales on the costa beneath and also on the inflated petiole; *sori* linear, straight, to about 5 mm long, extending from near the costa to 4 mm within the leaf-margin, simple, or forked along the forked veins, each consisting of about 20—40 sporangia with dense brown, branched paraphyses underneath and as long as the sporangia; sori on the pinnules of the lower pinnae shorter, of about 10—12 sporangia, starting from the costule but fall short of the leaf-margin; *spores* pale-colored, transluscent, round but angular with verrucose surface.

Southeast Yunnan: Markuan Hsien, Ching-kou (Lao Ching Shan), *K. M. Feng 13679*, December 7th. 1947, in mixed forest, rare, 1100—1300 m. alt.

One of the most distinct species in the genus, resembling *Marratia* in general habit. It can easily be distinguished from all the species known up to now by more memerous, much narrower and prominently dentate pinnae, of which the lower 3—4 are again pinnate, by the straight, patent and generally simple veins, as well as by much shorter sori starting from near the costa and extending outwards to within 4 mm of the leaf-margin.

2. Archangiopteris Cadieri Tard. et C. Chr. in Lecomte, Not. Syst. **5**: 8, pl. 1. fig. 1—2. 1936; in Fl. Gen. Indo-Chine **7**: 15. 1939.

Annam: Cua Tung, *Cadiere* san no. (type), Mars-Avril, 1932, 50—100 m. altitude.

This Annamise species from a rather low elevation differs from all others of the genus in the presence of spurious recurrent veinlets about 1 cm long each starting from the margin of pinnae downward between each pair of true veins, much in the manner of some species in *Angiopteris*, a character not known before in *Archangiopteris*. Another quite unique character of the species is the rather short sori, composed of about 35—50 sporangia, which extends outwardly to a short distance from the leaf-margin and inwardly leave a broad sterile space along each side of the costa, thus imparting to the plant a superficial resemblance to species of *Angiopteris*, which have a rather broad sterile area along the margin of the pinnae. Consequently, in several respects, the species seems to be an intermediate link between the two phyletically closely related genera, *Archangiopteris* and *Angiopteris*.

3. Archangiopteris hokouensis Ching, Ic. Fil. Sin. **5**: t. 204. 1958.　Pl. XLIX, 2.

Rhizome thick, suberect, 3—4 cm across, roots thickened, carnose, terete, blackish, simple, growing abundantly out from the under side of rhizome; *fronds* fasciculate, stipe to 50 cm long, 5 mm across, fleshy-herbaceous, green, provided above the base and throughout its entire length with 4—5 equally spaced nodose swellings in the appearance of a bamboocane and also copiously with dark-brown ovate-lanceolate scales having a cordate base; *lamina broadly* ovate, to 30 cm long,

38 cm broad, imparipinnate; lateral *pinnae* 2—3 pairs, subopposite or alternate, about 4 cm apart, 15—20 cm long, 5—7 cm broad, elliptic-lanceolate, petiolate (petiole about 1.5 cm long, swollen, scaly and dry blackish), apex caudateacuminate and coarsely serrate, narrowed towards cuneate base, margin coarsely arcuate-serrate, or crenate-dentate, the terminal pinna similar to the lateral ones but larger, 20—22 cm long, 7—9 cm broad; *veins* suberecte-patent, conspicuous, generally forked, or rarely simple, upcurved towards the margin and extending into the teeth; *texture* chartaceous, dark green above and pale green beneath, with moderately scattered short and articulate hairs; *sori* linear, 3—3.5 cm long or longer, separated by interstial space as broad, consisting of 160—240, 2-rowed sporangia, the sterile space along both the margin and the costa about 5 mm broad,, *paraphyses* very dense, filiform, branched, articulate, 10—15-celled, much longer than the sporangia, *spores* roundish or oblong, densely and minutely echinose.

Southeast Yunnan: Hokou, Nan-chi, *Chu Ve-ming 1726*, July 1955, in densely wooded moist ravine, 150 m. alt.

A remarkable species, differing from all other known species of the genus in having 4 or 5 nodose swellings above the base of the fleshy stipe, unusually broad elliptico-lanceolate serrate pinnae densely glandular hairy on the under surface, very long sori which extend from near the costa outwards to a short distance from the margin, and particularly in very long dense, branched shaggy paraphysate hairs almost completely covering the young developing sori.

4. Archangiopteris subrotundata Ching, Ic. Fil. Sin. 5: t. 206. 1958. Pl. L, 1.

Stipe 36—60 cm long, greenish, deeply grooved on the upper side, with one nodose swelling 20—30 cm above the base, copiously clothed especially in the lower part in reddish brown linear scales; *lamina* about 40 cm long and as broad, broadly ovate, simply impari-pinnate; *pinnae* 4—5-jugate below the similar terminal pinna, alternate, about 4 cm apart, petiolate (petiole 7 mm long, inflated), the basal pair much shortened (14 cm long) and like those next above rather strongly falcate, base rounded, the upper ones 22—25 cm long, to 5 cm broad at the middle, broadly linear-lanceolate, gradually acuminate, base rounded or subrounded, not cuneate, margin entire or at most slightly wavy below the dentate-serrate apical part; *texture* thin herbaceous, green, glabrous excepting on the sparsely scaly costa beneath; *veins* patent, distinct beneath, 4 mm apart, forked or simple, decidedly curved upward towards the margin; *sori* linear, generally 8—12 mm long, far apart, situated midway between the costa and margin, leaving an equally broad sterile space on each side, densely paraphysate with freely branched articulate hairs longer than the sporangia; *spores* oblong-reniform, finely echinose.

Southeast Yunnan: Si-chour Hsien, Faadoon, *K. M. Feng 12019*, Sept. 21th. 1947, in mixed forest, 1500—1600 m. alt.

Closely related to *A. Henryi* Christ et Gies. from the same region, but differs in the decidedly falcate lateral pinnae, of which the basal pair is only about half as long as those next above, in the broadly linear-lanceolate pinnae hardly narrowed towards the rounded or subrounded base, with entire or at most slightly wavy margin.

5. Archangiopteris caudata Ching, Ic. Fil. Sin. 5: t. 208. 1958. Pl. L, 2.

Rhizome suberect, about 2 cm across, roots long, thickened, carnose, unbranched, growing rather abundantly from the under side of rhizome, *fronds* solitary (according to the type), stipe 30—45 cm long, 3—4 mm across, green, subglabrous with a nodose swelling and geniculate about 16 cm above the base; *lamina* ovate, 30 cm long, about 25 cm broad, impari-pinnate; *pinnae* 2 pairs, subopposite, 5—6 cm apart, of similar size, 18 cm long, 4.5—5 cm broad at the middle,

broadly oblanceolate, gradually narrowed towards cuneate base, apex suddenly caudate (cauda 1.5 cm long, linear, serrate), margin from the base upward coarsely dentate, the endpinna similar to the lateral ones but slightly larger; *texture* herbaceous-chartaceous, green, both sides glabrous; *veins* suberect-patent, running from the costa outward under an angle of obout 60°, mostly forked or sometimes simple, upcurved towards the margin and extending into the teeth; *sori* linear, 8—10 mm long, falling short about 6 mm from both the margin and the costa, subcontiguous, each consisting of about 40—70, or rarely more sporangia, receptacle slightly elevated, *paraphyses* rather sparse, reddish-brown, articulate, much shorter than the sporangia and branched profusely from the base; *spores* globose-tetraedric, densely and minutely echinose.

Southern Kwangsi: Min River, Kang Nu Shan, specimens ex Herb. Kwangsi University, in ravine under the forest, about halfway up the mountain, October 2, 1935.

A very distinct species, differing from *A. Henryi* Christ et Gies. in oblanceolate pinnae with abruptly caudate apice, coarsely dentate leaf-margin, and in the very short and profusely branched paraphyses so completely hidden under the sori that their presence can hardly be detected from above.

6. Archangiopteris tonkinensis (Hayata) Ching, Ic. Fil. Sin. 5: t. 209. 1958. Pl. LI, 1.

Protomarratia tonkinensis Hayata in Bot. Gaz. 67: 88, fig. 1. 1919.

Archangiopteris tamdaoensis Hayata in Bot. Gaz. 67: 90, fig. 2. 1919; C. Chr. Ind. Fil. Suppl. III. 26, 1933; C. Chr. et Tard. in Lecomte, Not. Syst. 5: 5. 1935; in Fl. Gen. Indochine 7: 17. 1939.

Protaniopteris tamdaiensis Hayata in Bot. Mag. Tokio 42: 309, 1928.

Hainan: Five Finger Mount., Shan Ah Ping, *C. L. Tso 44148*, October 24. 1932, in woods, 3000 ft. alt.; southern slope of the same locality, *F. A. McClure 9470*, May 19. 1922, in wooded ravine; *C. Wang 35723*, December 20. 1933, by stream side.

Tonkin: Tamdao, *B. Hayata* (type), Août, 1917; *Pételot 3956*, Mai, 1913; environs de Chapa, Pételot Août, 1913, vers 1300 m. alt.

Annam: Cua Tung, *Cadiere* Mai, 1934.

Stipe 40—45 cm long, pale green, broadly grooved in its whole length above, scaly particularly near the base, with a nodose swelling at 20—30 cm above the base; *lamina* broadly obovate in outline, much shorter than stipe; *pinnae* 2—4 pairs, opposite, ovate-lanceolate, 20—25 cm long, 4—5 cm broad, petiolate (petiole about 5 mm long), gradually narrowed towards both ends, apex long-acuminate, base shortly cuneate, margin serrate with rather sharp arcuate teeth; *texture* more or less thickly chartaceous, glabrous above, very sparsely scaly beneath; *sori* 7—10 mm long, midway between the costa and margin, finely paraphysate with branched articulate hairs shorter than sporangia, finally becoming abraded; *spores* roundish-oblong, minutely and densely echinose.

The present species closely resembles *A. Henryi* Christ et Gies., differing in much longer stipes, which are about twice as long as the lamina, ovate-lanceolate, opposite pinnae with regularly and rather arcuately serrate margin, and in having paraphyses much shorter than the sporangia.

7. Archangiopteris latipinna Ching, Ic. Fil. Sin. 5: t. 207. 1958. Pl. LI, 2.

Stipe 47—55 cm long, 5 mm across, deeply sulcate above, moderately scaly in the lower part, with one nodose swelling at about 20 cm above the base; *lamina* oblong-ovate, 35—45 cm long, 26—30 cm broad, imparipinnate; *pinnae* 2—3-jugate, alternate, 4—5 cm apart, oblique, the basal pair only slightly shorter than the next pair above, the lower ones falcately recurved, the upper

ones to 20 cm long, 5—5.5 cm broad in the broadest part near the middle, broadly ovate-lanceolate, gradually narrowed towards the cuneate base, apice rather short-acuminate and serrate, margin entire and more or less repandulate; petiole about 1 cm long, scarcely inflated, subglabrous; *texture* thickly chartaceous, both sides glabrous, pale green beneath; *veins* lax, patent, forked or simple, antrorsely curved towards the margin, distinct on both sides; *sori* 1—1.5 cm long, midway between the margin and costa, leaving a sterile space about 7 mm broad equally as wide along the margin as along the costa, and separated from each other by broader interstial spaces; *paraphyses* quite dense, longer than the sporangia.

Southeast Yunnan: Ping-pien Hsien, *H. T. Tsai 60299*, June 19. 1934, in woods, 1200 m. alt.

For a long time I have considered the species the same as *A. Henryi* Christ et Gies. from the same region, from which, however, it really differs in the broadly ovate pinnae of a thickly chartaceous texture, of which the lower ones decidedly falcate, the rather short-acuminate apice, the repandulate leaf-margin, and the longer sori.

8. Archangiopteris Henryi Christ et Giesenhagen in Flora 86: 72—85. fig. 1—5, 1899; Christ in Bull. Herb. Boiss. 7: 14, 1899; Diels in Engl. u. Prantl: Nat. pflanzenfam. 1: 4. 439. 1899; C. Chr. Ind. Fil. 62, 1905; Hu et Ching, Ic. Fil. Sin. 1: t. 2. 1930; Cop. Gen. Fil. 15. 1947.

Rhizome suberect, about 2—3 cm across, fleshy, furnished with long naked thickened and fleshy roots, glabrous except the growing tips which are sparsely scaly; *fronds* fasciculate, stipe 40—60 cm long, or longer, about 2.5 mm across, broadly grooved throughout its whole length above, green, herbaceous, inflated slightly below the middle, copiously scaly especially towards the basal part with linear-lanceolate, fairly long, brown or dark-brown, thin, persistent *scales; lamina* as long as stipe, about 17 cm broad, ovate, simply pinnate; *pinnae* 2—4 pairs under the similar though often larger terminal pinna, which sometimes reaches to 30 cm long and 6.5 cm broad, alternate, oblique, about 5—6 cm apart, petiolate, the basal pair slightly shorter, 12—15 cm long, about 3 cm broad, the upper ones larger, 17—20 cm long, 4—5 cm broad in the broadest middle part, broad-lanceolate, gradually acuminate, base cuneate, gradually narrowed with the inflated, blackish and scaly petiole about 1 cm long. margin entire or slightly undulate, but acutely serrate towards apex; *veins* fine, lax, about 4 in 1 cm, very patent, distinct on both sides, mostly once forked, or often with simple and forked ones alternating, attenuate and upcurved at the apex ending a short distance within the margin; *texture* herbaceous, dry green, glabrous on both sides except the costa on the lower surface provided with a few brown, linear-lanceolate scales; *sori* linear, straight, 10—20 mm long, separated by spaces equally broad, consisting of 60—160 sporangia, situated midway between the costa and margin, densely paraphysate underneath with reddish, fine, articulated branched hairs longer than the sporangia.

Yunnan: Mengtze, mountains to the southeast, *A. Henry 11544* (type), in forest, 5000 ft. alt.; Pin Pien Hsien, Ta Wei Shan *K. M. Feng 4605*, Sept. 21. 1954, in moist wooded ravine, 1100—1200 m. alt.; *K. M. Feng 5078*, under the moist forest, October 18. 1954; *C. W. Wang 82370* (1939); Mar-li-po, Kwan Kao, on the border of Tonkin, *C. W. Wang 86938*, Feb. 16th. 1940, in densely wooded valley, 1200 m. alt.

The species is the type of the genus *Archangiopteris* now found to be fairly common under evergreen forests in Ta Wei Shan in the districts of Ping Pien and Hokou, Southeast Yunnan.

Its salient characters are the lanceolate and alternate pinnae gradually acuminate and serrate at the apex, gradually attenuated to a cuneate base, the entire or undulate or at most undulate

dentate along the margin, and the inflate and blackish scaly petiole which averages about 1 cm long. The paraphyses under the sori are rather dense and shaggy, of a brownish color, and longer than the sporangia.

9. Archangiopteris subintegra Hayata in Bot. Gaz. 67: 90, fig. 1. 1919; C. Chr. Ind. Fil. Suppl. III. 26. 1936; Tard. et C. Chr. in Lecomte, Not. Syst. 5: 5. 1935; in Fl. Gen. Indochine 7: 15. 1939.

Tonkin: entre Chapa et Muong Xen, on the Chinese border, *B. Hayata* (type), July 1917; entre Chapa et Ta Phinh, *Pételot,* Sept. 1932 m vers 1550 m. alt.

Petiole to 70 cm long, the basal part covered with scales which are lanceolate from a broad rounded base, marked by a single inflated articulation below the middle; *lamina* obovate, imparipinnate; *pinnae* 5—7 pairs, lanceolate, petiolate (petiole 7 mm long, inflated and scaly), 20—25 cm long, 3—5 cm broad, abruptely contracted towards the apex into a linear acumen 2—3 cm long, base oblique, margin subentire or undulate, repand; *texture* thin; *sori* 1 cm long, equally distant from both the margin and the costa, thinly paraphysate; *spores* round, minutely echinose.

The species might well be regarded as a form of *A. Henryi* Christ et Gies. which has been already recorded from the same region.

10. Archangiopteris Somai Hayata, Ic. Pl. Form. 5: 256. 1915; 6: 154. fig. 60, Pl. 19. 1916; C. Chr. Ind. Fil. Suppl. I. 4. 1916; Suppl. III. 26. 1933; Nakai in Bot. Mag. Tokio 41: 78. 1927; M. Genkai, Short Fl. Form. 1. 1936; H. Ito, Fil. Jap. Illustr. Pl. 498. 1944; Ching, Ic. Fil. Sin. 5: t. 205. 1958. Pl. LII. *Angiopteris Somai* Hayata apud Makino et Nemoto, Fl. Jap. 1563. 1925.

Protangiopteris Somai Hayata in Bot. Mag. Tokio 42: 308. 1928.

Taiwan: Bahao, *T. Soma* (type), December 1910; Rengechi. Taichu, *S. Sasaki,* March 3, 1927; *Yamamota & Mori,* 2—3 Nov. 1932; Taihoku-syu, Bunzon-gun, Kanica, Y. Yamamota, July 24. 1938.

A fairly common fern in mountain forests in the southern, middle and northern parts of the island. *Stipe* 50—60 cm long, scaly in the lower part, with one nodose swelling at about 25 cm above the base; petiole 1 cm long; *pinnae* 3—5, 20 cm long, 4 cm broad, oblanceolate, slightly narrowed from the middle downward into a rather broadly cuneate base, apex caudate-acuminate with a linear acumen 3—4 cm long; *veins* very patent, alternately forked and simple; margin repand, rather irregularly crenate-dentate above the base; *sori* linear, to 1.5 cm long, medial, leaving a broad sterile space on each side of costa and along the margin.

The Taiwan species, of which I have seen half a dozen specimens, is quite near *A. Henryi* Christ et Gies. from the mainland, and seems to differ in elongate oblanceolate pinnae of a thicker texture with crenate-dentate and often repand margin.

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Explanation of Plates

Plate XLIX, 1. *Archangiopteris bipinnata* Ching.
1. Habit sketch × ⅜;
2. Part of pinna, showing venation, serrature and sori, × 1.5;
3. Scale from the lower part of stipe, × 15;
4. Two sporangia attached to the vein with paraphyses, × 15;
5. Two sporangia detached, showing longitudinal slit on the ventral side, × 7.5;
6. Paraphysis detached from the sori, × 37.5;
7. Spores, × 37.5.

Plate XLIX, 2. *Archangiopteris hokouensis* Ching.
1. Habit sketch, × ⅜;
2. Part of pinna, showing venation, serrature and sori, also hairy under surface, × 1⅛;
3. Scale from the lower part of stipe, × 15;
4. Two sporangia attached to the vein with paraphyses, × 7.5;
5. Two paraphyses removed from the sori, × 22.5;
6. Spores, × 37.5, one enlarged, × 150.

Plate L, 1. *Archangiopteris subrotundata* Ching.
1. Habit sketch, × ⅜;
2. Part of pinna, showing venation, leaf-margin and sori, × 1.5;
3. Scale from the lower part of stipe, × 11.25;
4. Two sporangia attached to the vein with paraphyses, × 7.5;
5. Two paraphyses removed from the sori, × 37.5;
6. Spores, × 37.5, one enlarged × 150.

Plate L, 2. *Archangiopteris caudata* Ching.
1. Habit sketch, × ⅜;
2. Part of pinna, showing venation, serrature and sori, × 1.5;
3. Scale from the lower part of stipe, 11.25;
4. Two sporangia attached to the vein with short paraphyses, × 7.5;
5. Paraphyses removed from the sori, × 37.5;
6. Spores, × 37.5, one enlarged, × 150.

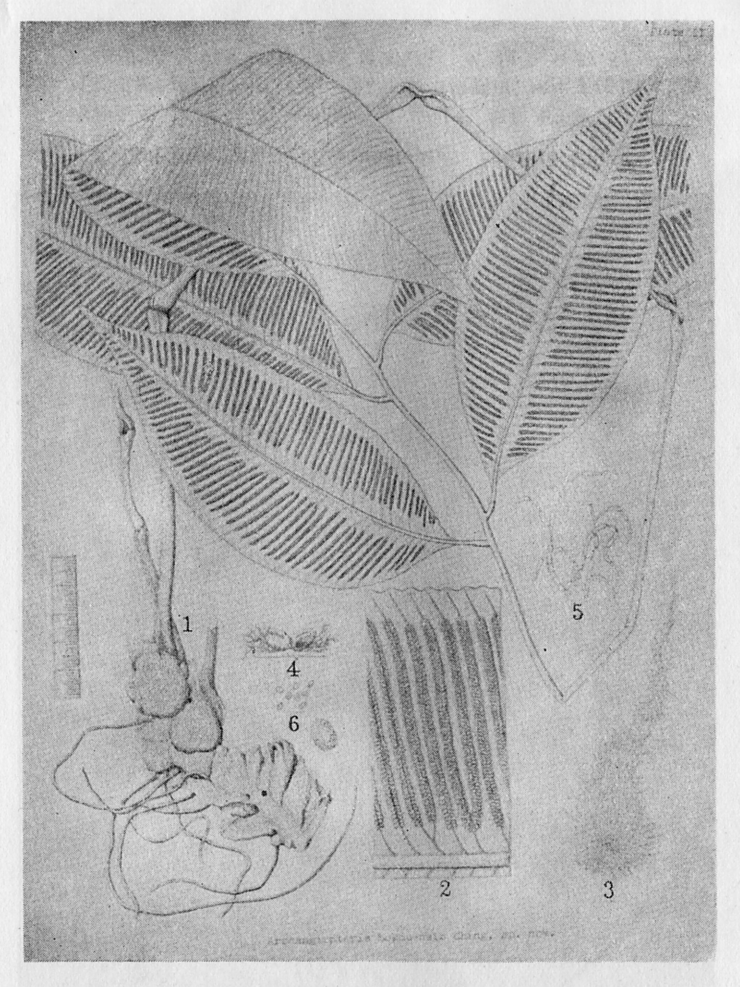
Plate LI, 1. *Archangiopteris tonkinensis* (Hayata) Ching.
1. Habit sketch, × ⅜;
2. Part of pinna, showing venation, serrature and sori, × 1.5;
3. Scale from the basal part of stipe, × 11.25;
4. Two sporangia attached to the vein with paraphyses, × 7.5;
5. Paraphyses removed from the sori, × 37.5;
6. Spores, × 37.5, one enlarged, × 150.

Plate LI, 2. *Archangiopteris latipinna* Ching.
1. Habit sketch, × ⅜;
2. Part of pinna, showing venation, leaf-margin and sori, × 1.5;
3. Scale from the lower part of stipe, × 11.25;
4. Two sporangia attached to the vein with paraphyses, × 7.5;
5. Paraphysis removed from the sori, × 37.5;
6. Spores, × 37.5, one enlarged, × 150.

Plate LII. *Archangiopteris Somai* Hayata.
1. Habit sketch, × ⅜;
2. Lower part of pinna, showing venation, serrature and sori, × 1.5;
3. Scale from the lower part of stipe, × 11.25;
4. Cross section of the basal part of stipe, × 1.5;
5. Cross section of the middle part of stipe, × 1.5;
6. Cross section of the upper part of stipe, × 1.5;
7. Two sporangia attached to the vein with paraphyses, × 7.5;
8. Phraphyses removed from the sori, × 37.5;
9. Spores, × 37.5, one enlarged, × 150.

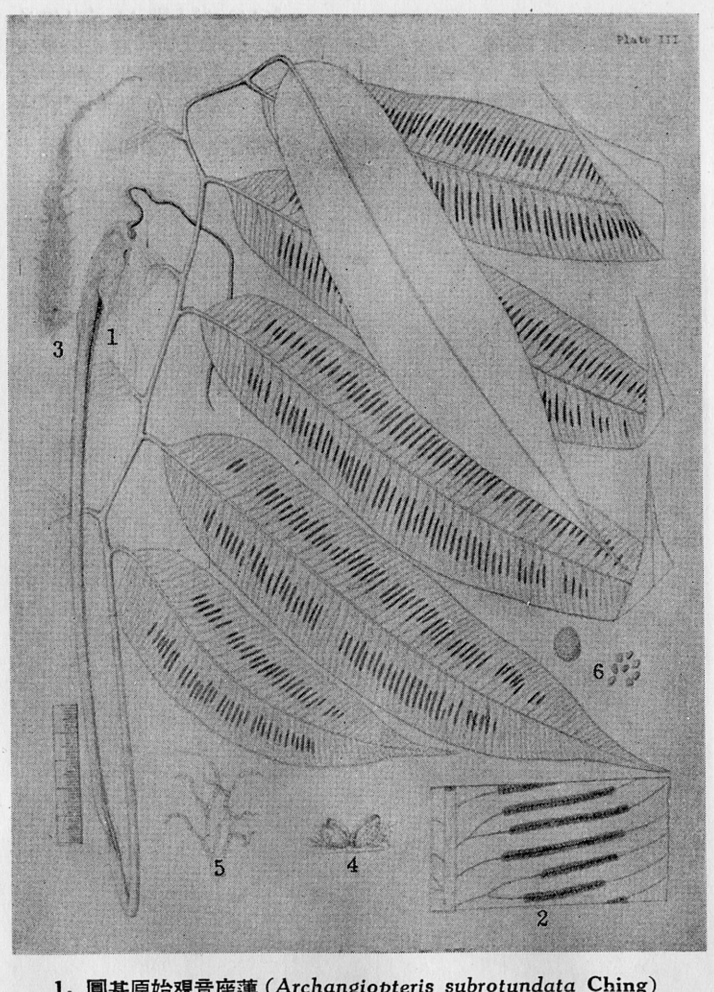
1. 二回原始观音座蓮（*Archangiopteris bipinnata* Ching）

1. 本种全形，× 3/8； 2. 一回羽片的一部分，示叶脉与子囊羣，× 1 1/8； 3. 叶柄下部的鳞片，× 15； 4. 两个孢子囊着生于有夹毛的托上，×15； 5. 两个分离的孢子囊，示腹面的縱裂縫，× 7.5； 6. 子囊羣下的夹毛，× 37.5； 7. 孢子，× 37.5。



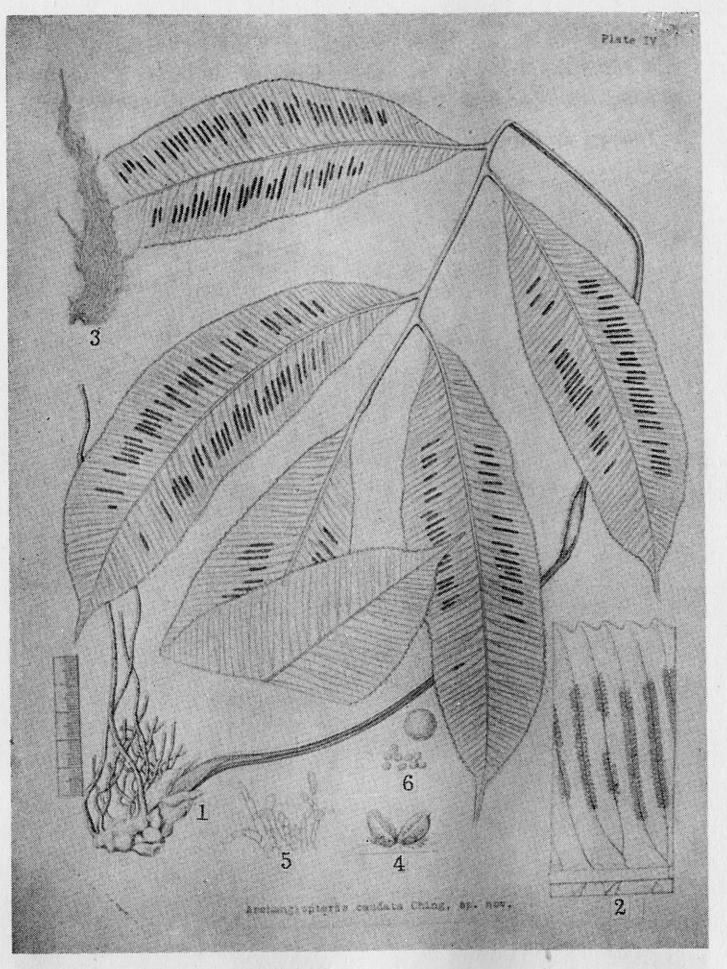
2. 河口原始观音座蓮（*Archangiopteris hokouensis* Ching）

1. 本种全形，× 3/8； 2. 羽片的一部，示叶脈、鋸齿、子囊羣和下面的腺毛，× 1 1/8； 3. 叶柄下部的鳞片，× 15； 4. 两个着生于托上的子囊和夹絲，× 7.5； 5. 两根夹絲，× 22.5； 6. 孢子，× 37.5，另一个× 150。



1. 圓基原始观音座蓮（*Archangiopteris subrotundata* Ching）

1. 本种全形，× ⅜；　2. 羽片的一部，示叶脈、叶緣和子囊羣，× 1.5；3. 叶柄下部的鱗片，× 11.25；　4. 两个孢子囊着生于有夹絲的托上，× 7.5；　5. 二条夹絲，× 37.5；　6. 孢子，× 37.5；另一个 × 150。

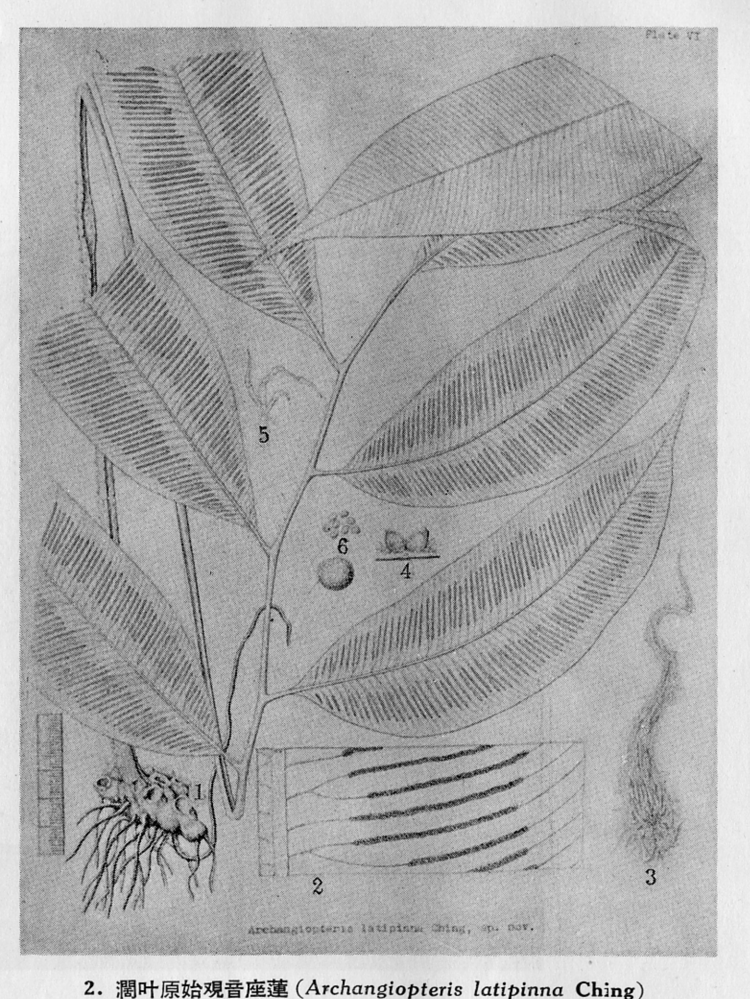


2. 尾叶原始观音座蓮（*Archangiopteris caudata* Ching）

1. 本种全形，× ⅜；　2. 羽片的一部，示叶脈、鋸齿及子囊羣，× 1.5；3. 叶柄下部的鱗片，× 11.25；　4. 子囊羣横断面，示生于托上的二个子囊和短夹絲，× 7.5；　5. 夹絲，× 37.5；　6. 孢子，× 37.5，另一个 × 150。

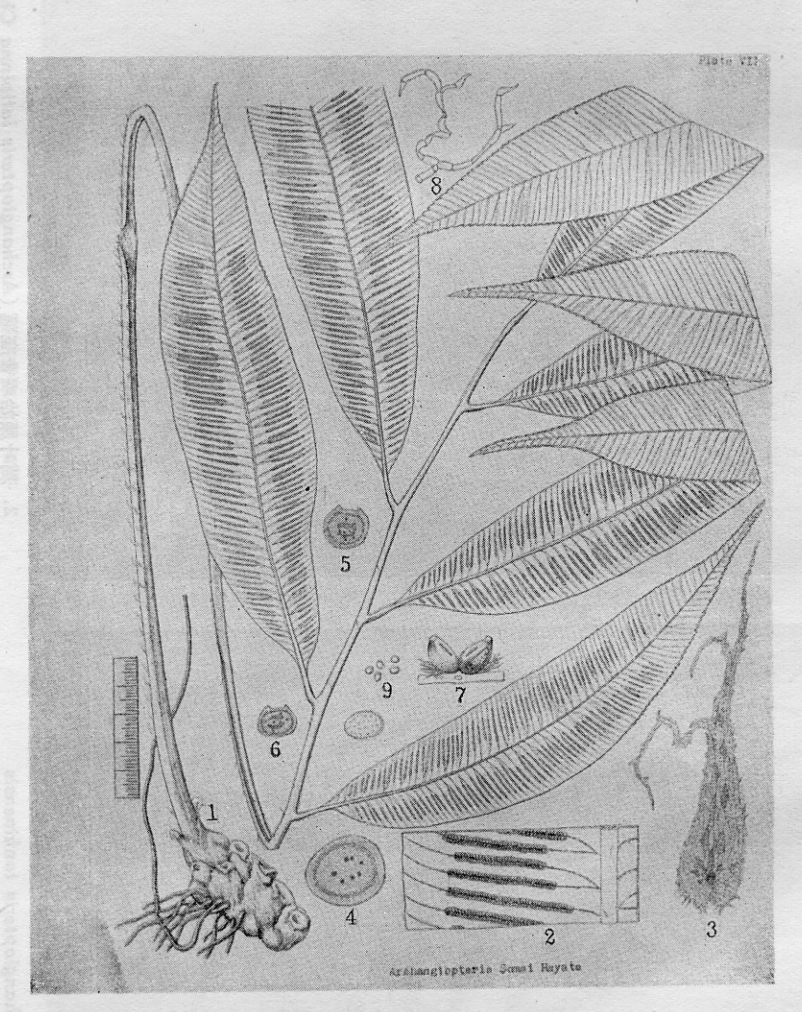
1. 尖叶原始观音座蓮（*Archangiopteris tonkinensis* (Hayata) Ching）

1. 本种全形，× 3/8；　2. 羽片的一部，示叶脈、鋸齿和子囊羣，× 1.5；　3. 叶柄基部的鱗片，× 11.25；　4. 两个孢子囊着生于有夹絲的托上，× 7.5；　5. 子囊羣下的夹絲，× 37.5；　6. 孢子，× 37.5，另一个 × 150。



2. 濶叶原始观音座蓮（*Archangiopteris latipinna* Ching）

1. 本种全形，× 3/8；　2. 羽片的一部，示叶脈，鋸齿和子囊羣，× 1.5；　3. 叶柄下基的鱗片，× 11.25；　4. 两个孢子囊着生于有夹絲的托上，× 7.5；　5. 子囊羣下的夹絲，× 37.5；　6. 孢子，× 37.5，另一个 × 150。



台灣原始观音座蓮(*Archangiopteris Somai* **Hayata**)

1. 本种全形, × 3/8; 2. 羽片的一部, 示叶脈, 鋸齿和子囊羣, × 1.5; 3. 叶柄下部的鱗片, × 11.25; 4. 叶柄下部的横切面, × 1.5; 5. 叶柄中部的横切面, × 1.5; 6. 叶柄上部的横切面, × 1.5; 7. 两个孢子囊着生于有夾絲的托上, × 7.5; 8. 子囊羣下的夾絲, × 37.5; 9. 孢子, × 37.5, 另一个 × 150。